HIDRAULICA

TDZ

POWER-STEERING

INTRODUCTION

FITTING

The TDZ HYDRAULIC SERVO-STEERING can be adapted to all kinds of vehicles fitted with mechanical diggers, lorries, buses, fork-lift trucks, etc...

The different models which are built to be adapted to the different vehicles, are determined by the following two main principles:

A) Type of HYDRAULIC PUMP, with working according to:
- Flow to be supplied (l / min.)
- Speed of rotation (r.p.m.)
- Work pressure (kp /cm^2)

B) Type of CYLINDRE/DISTRIBUTOR with power, according to:
- Sstroke of piston (mm.)
- Maximum power to be developed (scales of power/resulting pressure)

CHARACTERISTICS

The strength necessary in the steering wheel to move the wheels of a vehicle equipped with TDZ SERVO-STEERING, is reduced to values of very few kgs. (Proportion of 1/75 to 1/100) even under unfavourable driving conditions, allowing the driver to carry out, with minimum effort, difficult steering manoeuvres which can occur on uneven land or in the town traffic.

As result, the behaviour of the vehicle will always be smooth, precise and safe.

The TDZ SERVO-STEERING also works as a hydraulic stabilizer of the steering, absorbing the vibrations produced by uneven paving and preventing them from reaching the steering box and the wheel, in this way contributing to these elements lasting longer.

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The main advantages of the TDZ SERVO-STEERING can be resumed in:

- Less effort used in driving, reducing considerably the driver's fatigue. With strength of the steering wheel's driver of 2 to 5 kgs. 800 to 1500 kgs. strength can be obtained on the wheels.

- Easy manoeuvre and flexibility sensation. The physical couple applied to the steering wheel is always proportional to that applied to the wheels.

- Reversibility:

The normal reversibility of the vehicle is not affected by the placing of the servo-steering, allowing the tendency to recuperate the initial position. If necessary, this recuperation can be carried our with as much intensity as believed necessary.

- Safety:

In case of a burst tyre, it instantaneously corrects and acts in the opposite direction to the turning tendency which the bursting of the tyre imparts to the steering.

-Turning angle

The assembly of the TDZ SERVO-STEERING Ddoes not at all affect the turning marks and angles of the steering.

- Gearing down.

If it were necessary for certain cases, a steering can be assembled with less gearing down in the mechanism box, being able to reduce, logically the dimensions of the steering wheel. This characteristic can have its importance in rapid vehicles (lorries, coahes, etc...) as increases the speed necessary in the manoeuvre.

NOTE: In case of breaksown of the hydraulic system of the TDZ SERVO-STEERING, the vehicle is not left without steering, but it continues with its normal mechanical steering. (If this case is reached, we recommend taking out or cutting the operating belt of the hydraulic pump so that it does not continue working without load, until the breakdown of the hydraulic system is repaired).

DESCRIPTION

COMPOSING ELEMENTS

The TDZ hydraulic SERVO-STEERING, is made up of the following elements:

1.- Vane Hydraulic Pump.
2.- Tank/Filter
3.- Cylinder/Distributor.
4.- Hydraulic Oil.
5.- High and low pressure pipings..
6.- Fixing supports and accessories.

1.- VANE HYDRAULIC PUMP

Vane Hydraulic Pump, can be moved and with double effect which supplies the cylinder with a constant flow of oil. The pump has also incorporated:

a) Flow regulation valve: mounted on the inside of the pump itself. In this way, the variable speed of the pump in function of the engine's revolutions, does not influence the outlet constant flow.

b) Safety valve: susceptible to be gauged up to a maximum pressure of 140 kgs./cm2 in accordance with the characteristics of the servo-steering and of the vehicle to be mounted.

NOTE: All the pumps are supplied with both regulations already established.

c) Transmission pulley: For the transmission of the turning movement the pump, a pulley is normally incorporated with the following characteristics:

Pulley Reference	*Dimension (Diameter x channel wide)*	*Channel Nr.*
PV01011	105 x 10 mm.	1
PV01000	134 x 10 mm.	1
PV01005	134 x 16 mm.	1
PV01008	134 x 10 / 10 mm.	2

The one needed must be indicated in each case, on order, but a pulley with different measurement and of different kind can also be supplied, as well as in certain cases, with direct coupling.

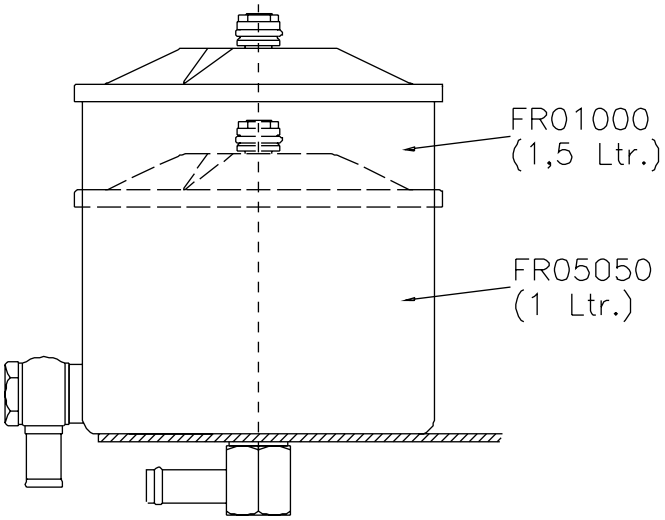
The pumps used in the TDZ Servo-steering are the following:

Type	*Tank (l.)*	*Flow at 1000 r.p.m. (l/min.)*
B2V	without tank	until 15
B2VC	1,5	until 12
B2VA	1	until12

2.- TANK/FILTER

Normally, the oil tank is assembled on the hydraulic pump itself, on being placed in the vehicle, if there is enough space for both. If not, it must and can be placed independently.

The pipings, in one case or another, are carried out according to that indicated in installation diagrams.



Tank according to the hydraulic circuit, has incorporated inside:

a) A filtering cartridge of paper conserves to the maximum the purity and cleanness necessary for the hydraulic oil.
Filtering passage: 10 µm.

b) Safety valve (Gauged from 100 to 200 grs.) placed in the inside of the butterfly-screw which closes the cover an which is activated in case of an extra pressure being created in the inside of the tank, at the same time as it prevents the oil from coming out through the breathing orifice as a result of the vibrations of the engine.

3.- CYLINDER/DISTRIBUTOR

The construction of the different types of standard Cylinders with double effect for the TDZ SERVO-STEERING, are adjusted to the measurements indicated in the dimensions sheets.

As indicated there, the characteristics of the different cylinders will be in function of the vehicle where they have to be assembled, mainly with regard to:

a) Cylinder stroke, in accordance with the length and run of the push rod of the wheels

b)The coupling end must be indicated exactly according to the variants given. It can be also supplied without being roughed down so that, on mounting it on the vehicle, it can be mechanized with regard to the ball and socket joint where it is going to be installed.

c) The joint ball of the steering rod is sent, if the opposite is not indicated, with extra measurement so that it can be mechanized according to its coupling (mechanize to the measurement of the inside diam. of the steering bar).

These characteristics must be taken into account to couple, normally, the Cylinder to the steering rod and to the operating rod of the wheels.

This cylinder has the Distributor incorporated in order to adjust and distribute the hydraulic flow to the push chambers of the piston rod.

It also has a safety valve incorporated so that, in case the pump turns in the opposite direction to the normal one, the steering does not operate.

It also has reaction chambers to sensitize the driving of the vehicle.

The entry and return of the oil to the distributor can be placed, turning them in the most convenient position, as well as the joint ball to the steering rod, too. These changes must be noted, if necessary, when the request for supply is made.

Apart from the standard characteristics described, the Cylinders can be manufactured with different strokes and with the ends and the joint balls completely finished according to the measurements requested.

4.- HYDRAULIC OIL

The hydraulic oil used in the TDZ SERVO-STEERING must have the following characteristics:

- From 3º to 3.5º E to 50ºC.

- Viscosity index: 130

OPERATION

The servo-steering circuit is a closed one and independent from the rest of the hydraulic circuits of the vehicle where it is installed. Its design has been conceived and developed according to this criterion. And it is advisable, in any case, to have this total independence if we wish it to work properly, constantly and without break-downs..

However, it can also be coupled to another hydraulic circuit of the vehicle, always bearing in mind that:

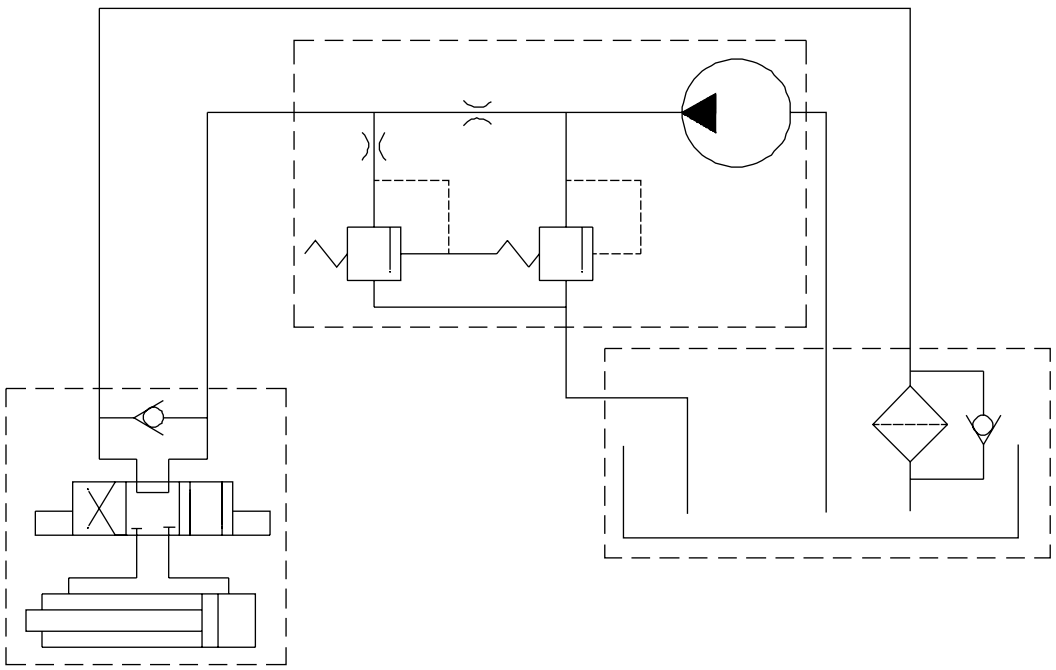
a) The oil flow sent by the pump must be enough. For the standard cylinders described it will be 9 l/min. as minimum. This flow, as a result, must be necessary to move the cylinder to the adequate speed and with sufficient speed of turning.

b) The hydraulic oil must be of the quality and viscosity demanded below, characteristics which a high precision circuit such as this requires.

The use of other oils can destroy, in a short time, the pump as well as produce leak from the stopper and overheating.

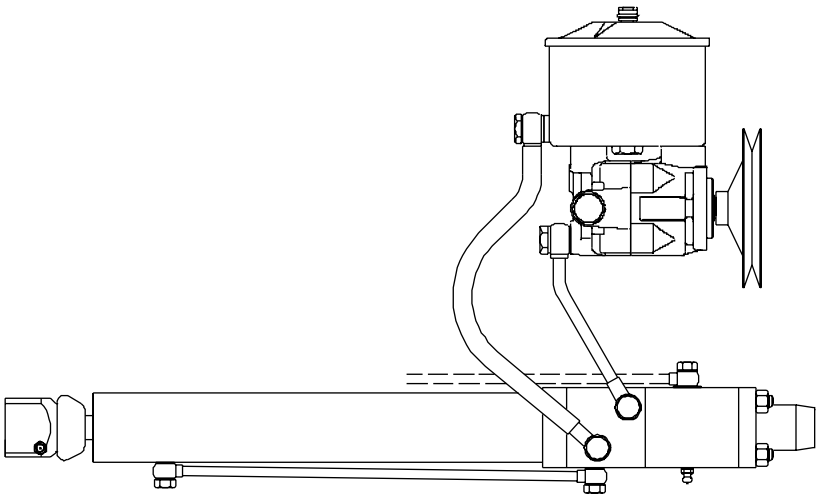
c) VERY IMPORTANT: The circuit must have paper filtering cartridges or the equivalent, with a degree of filtering of 10 µm.

1.- HYDRAULIC CIRCUIT

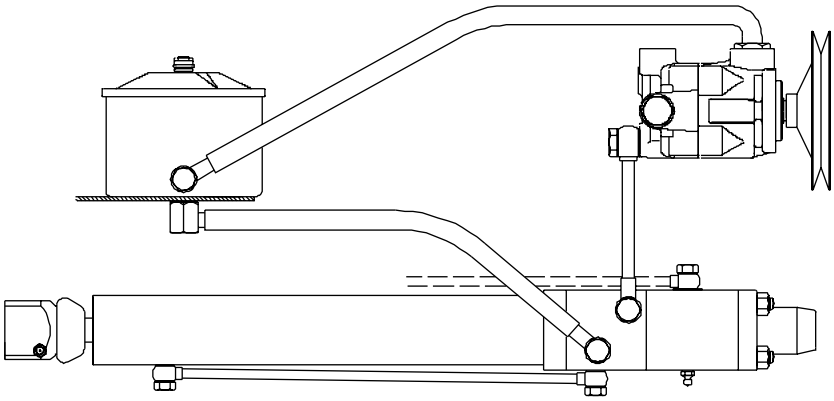


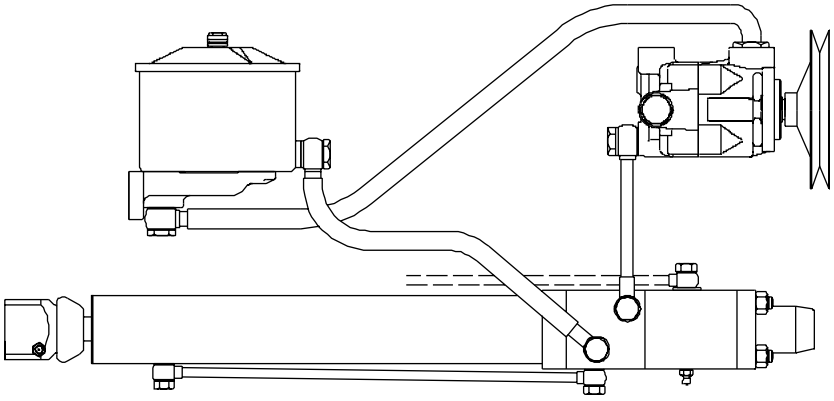
2. INSTALLATION DIAGRAMS

Tank incorporated to the pump



Tank independent from the pump





3.- GENERAL DESCRIPTION OF THE OPERATION

In accordance with the installation diagrams anteriority explained, the energy necessary to activate the servo-steering is given by the vane pump. This pump receives the movement from the engine, by means of pulley coupled to the pump itself and by means of a V-belt. Normally a supplementary pulley must be placed on the end of the engine's crakshaft.

The pump breathes oil from the tank and sends it, under pressure and through the high pressure pipe, towards the distributor coupled to the activating cylinder. This delivery is carried out always when the engine is working, even when the steering wheel is not activated because the vehicle is moving in a straight line or is parked. The return of the oil goes to the tank through the own pressure pipe.

When the vehicle is driven in a straight line (or when it is parked with the engine running), the pump works without pressure and the oil circulates through the cylinder, without opposition

When the steering wheel turns, its movement is transmitted to the steering rod and to the distributor ball, activating it in one way or another, so that the pump stops working without load to transmit to the cylinder the flow and power necessary.

In order to fix the cylinder, it has three ball and socket joints:

1.- One, at the end of the piston plunger and which must be mounted on a support, fixed to the chassis of the vehicle.

2.- Another, joined to the steering rod coupled to the control distributor situated on the inside of the cylinder.

3.- And another, joined to the attack lever which directly transmits the turning movement to the wheels.

This last movement is produced by the entry or exit of the cylinder plunger, pushed by the oil on one side or another. This distribution of the oil regulates it and measures out the distributor on being moved by the ball joined to the steering rod in its run in one direction or another.

The oil circulation in the distributor in order to produce the movement of the plunger, is indicated graphically in its three positions:

- Neutral position: Circulation without pressure.

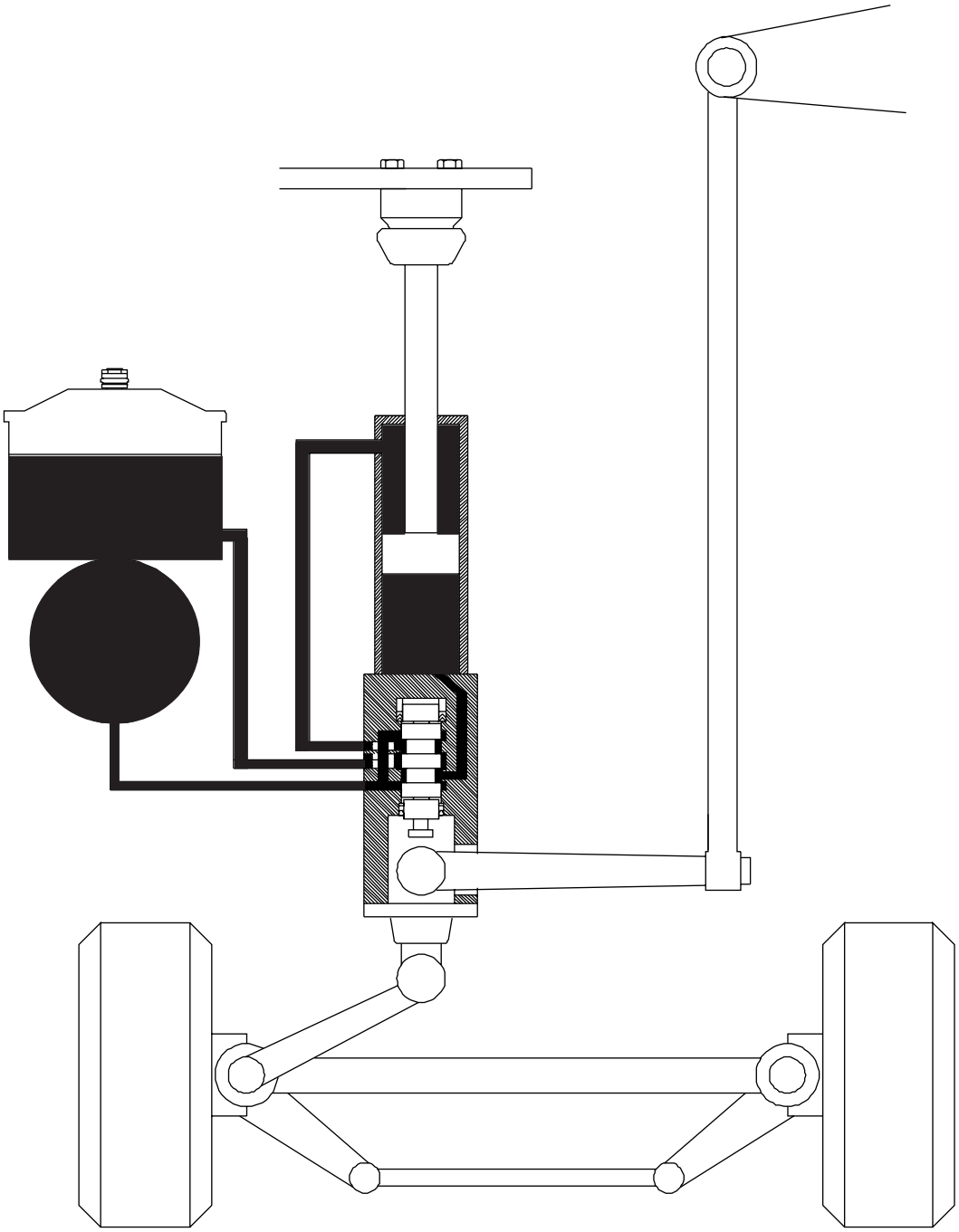
- Exit of the plunger.

- Entry of the plunger.

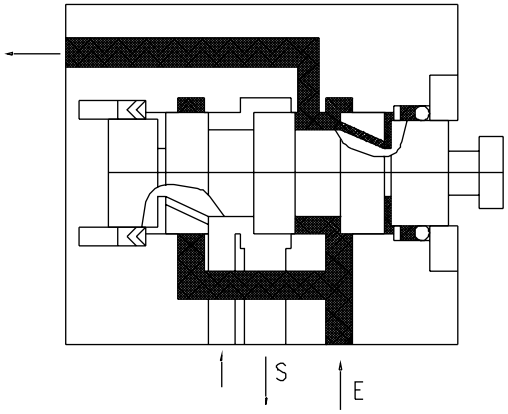
As a result, according to whether the cylinder is placed on the right or left of the vehicle (looking from the driver's seat through the windscreen) the movement of the plunger will be:

Placed on the right	Placed on the left
Exit plunger = Right turn	Exit plunger = Left turn
Entry plunger = Left turn	Entry plunger = Right turn

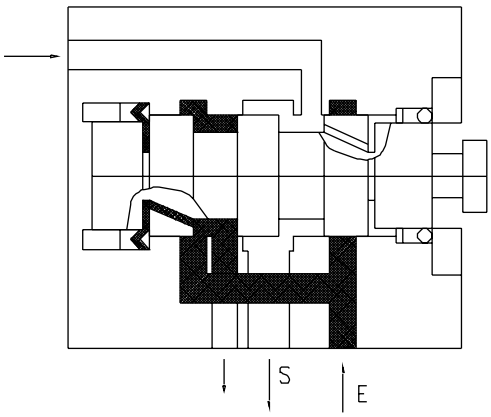
Neutral position: Circulation without pressure



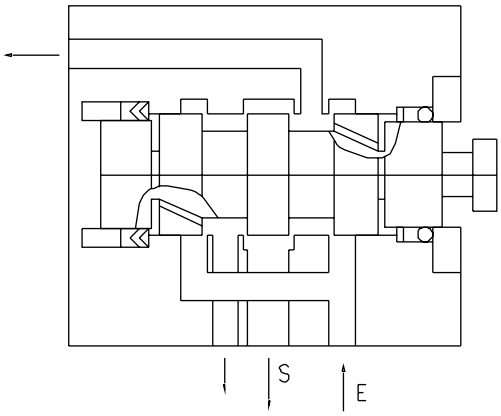
Exit of the rod



Entry of the rod



Neutral position



ASSEMBLY

Taking it into account that this is a high precision circuit, all the norms which are indicated below must be rigorously followed when assembling the TDZ SERVO-STEERING, if it is wished to work correctly in the vehicle where it is installed.

Any mistake in assembly can affect, directly or indirectly, the composing elements, and therefore, because of anomalies.

INSTALLATION OF THE HYDRAULIC VANE PUMP

In each case, the most suitable place will be looked for the installation of the hydraulic pump, taking into account.

1.- TRANSMISSION

Unless otherwise indicated the pump has a pulley incorporated according to the measurements above indicated.

The transmission for the operation of the pump will be carried out by means of V-belt, placing a supplementary pulley on the end of the engine crankshaft.

The transmission ratio must be calculated so that the pump turns at:

- Minimum speed of 600 r.p.m. with engine turning over.

- Maximum speed of 4000 r.p.m. with engine at to speed.

This calculation of speeds will determine the diameter of the supplementary pulley to be placed on the end of the engine crankshaft.

2.- SUPPORT OF THE PUMP

The support will be placed so that, once the pump has been mounted, the latter is perfectly in line with the above mentioned supplementary pulley. The V-belt must also be able to be tightened without greater difficulty.

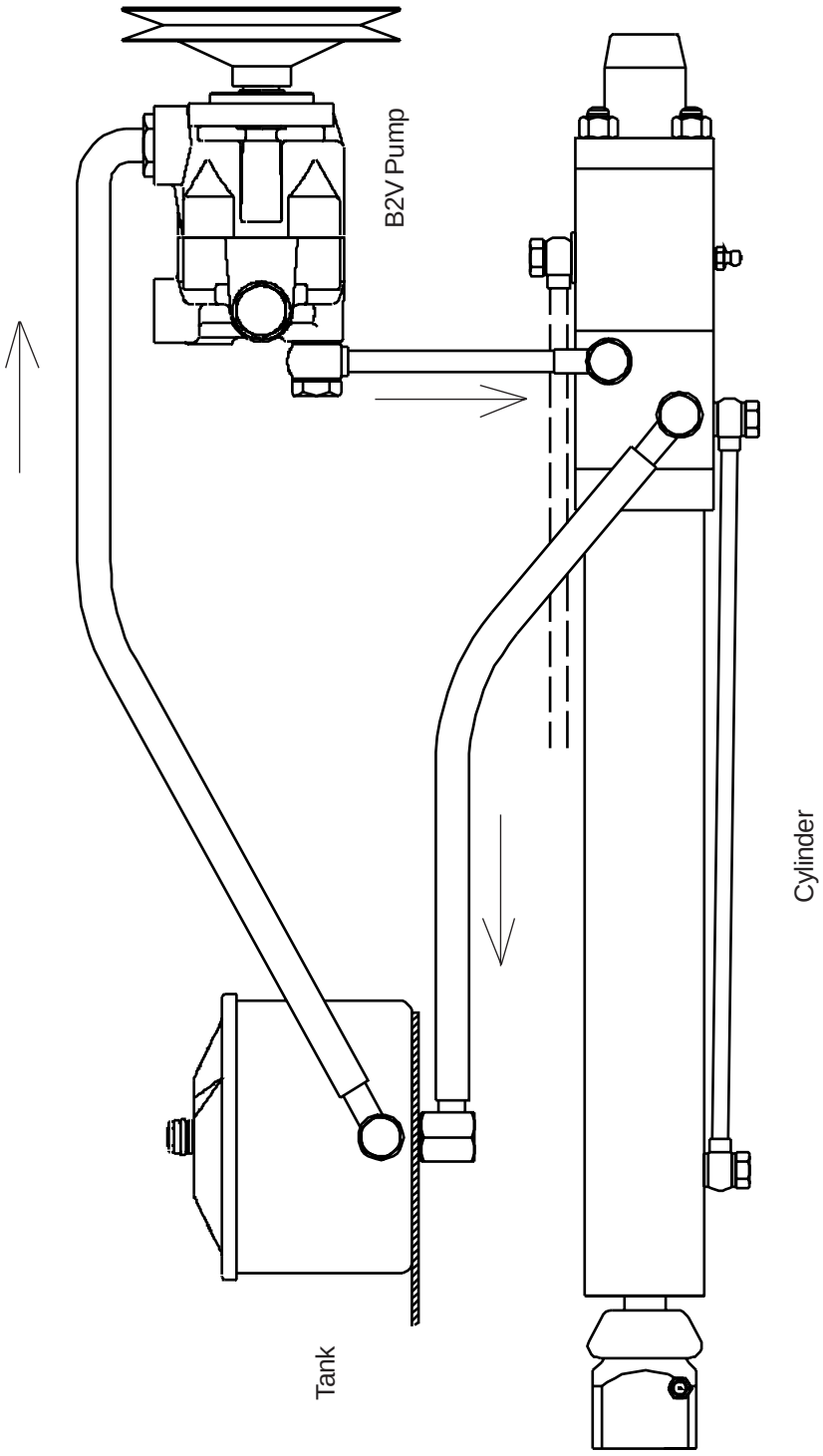
3.- TANK

If it necessary to place a tank independent from the pump, it must be done in an accessible place, on high and as near as possible to the pump.

The support of the tank is recommended to have a minimum thickness of 5 mm. in order to avoid vibrations and deformations,

The joint of the outlet of oil from the tank with entry of the pump can be done with a synthetic rubber pipe, of low pressure, and with inner diameter of 13 mm.

Operation diagram with tank independent from the pump



INSTALLATION OF THE CYLINDER/DISTRIBUTOR

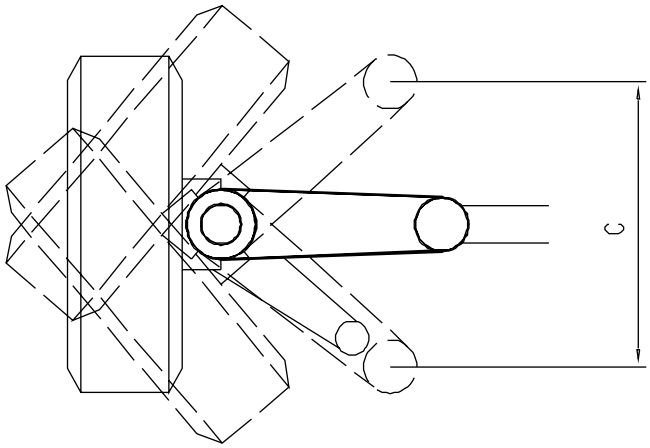
1.- PLACING OF THE CYLINDER

It will be always be on the side of the vehicle where the steering rod is found.

2.- STROKE

Turning the driving wheels by means of the steering wheel, from one end to the other as far as possible to both sides, taking a point of reference, the stroke of the lever which activates the movement of the wheels will be measured. Said measurement will be carried out on the end of the lever which is coupled to the steering rod.

The stroke necessary of the cylinder must always be, as minimum 10 mm. greater than the stroke obtained previously.



Minimum stroke of the cylinder = C + 10

INSTALLATION OF THE CYLINDER

Placing the wheels in the centre of their run, the steering rod will come away from its point of union with the lever which activates the movement of said wheels.

The end of the cylinder will be mechanized to mount on it the ball and socket joint which substitutes that which the steering rod has.

Afterwards, and conserving the wheels in the centre, the ball and socket joint of the end of the cylinder will be mounted on the point of union of the lever. With the rod of the cylinder in the middle of its stroke and placing it horizontally, it will indicate the place where a 10 to 15 mm. diameter must be placed, joined to the chassis with three 10 to 12 mm. diameter screws and which will help to hold by means of another four 8 mm. diameter screws, the ball and socket joint of the end of the rod.

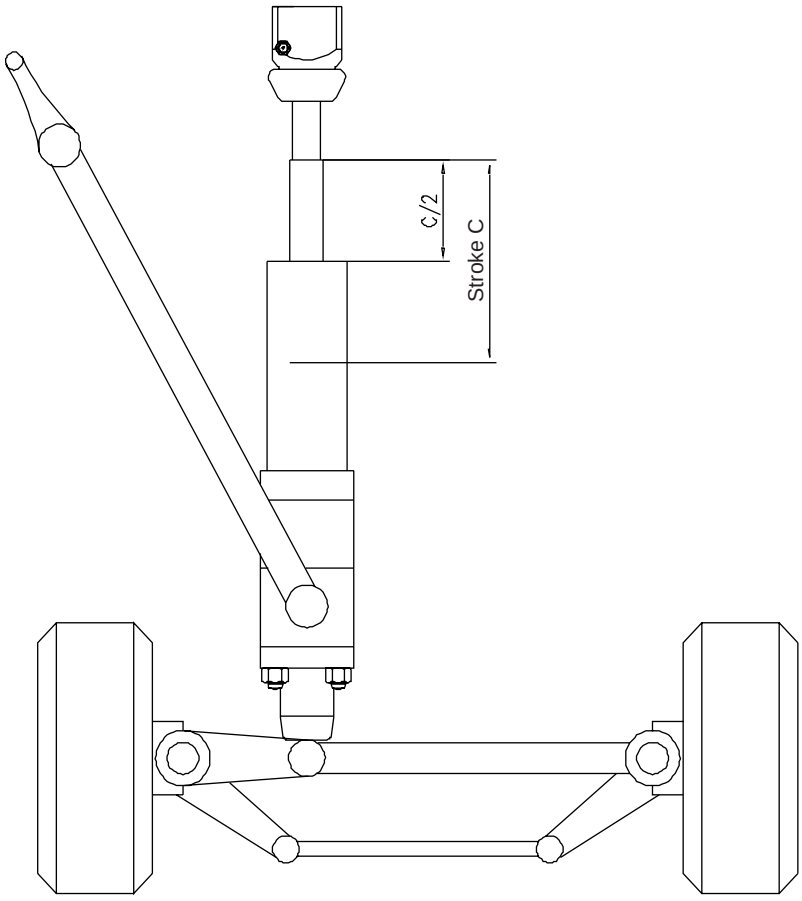
STEERING ROD

In this position (cylinder in the middle of its stroke and the wheels in the centre of their run), the length of the steering rod will be that which results from placing the connecting rod which comes from the steering box, in the centre of its run, to the union ball which is mounted on the cylinder.

Once this length has been found, the steering rod will be cut according to said measurement and will be welded to the union ball.

The steering rod, if it were necessary, will be bent a few centimetres before being coupled to the ball and socket joint, so that it remains completely parallel to the cylinder in order for the ball and socket joint to be completely centred and totally vertical in the neutral position.

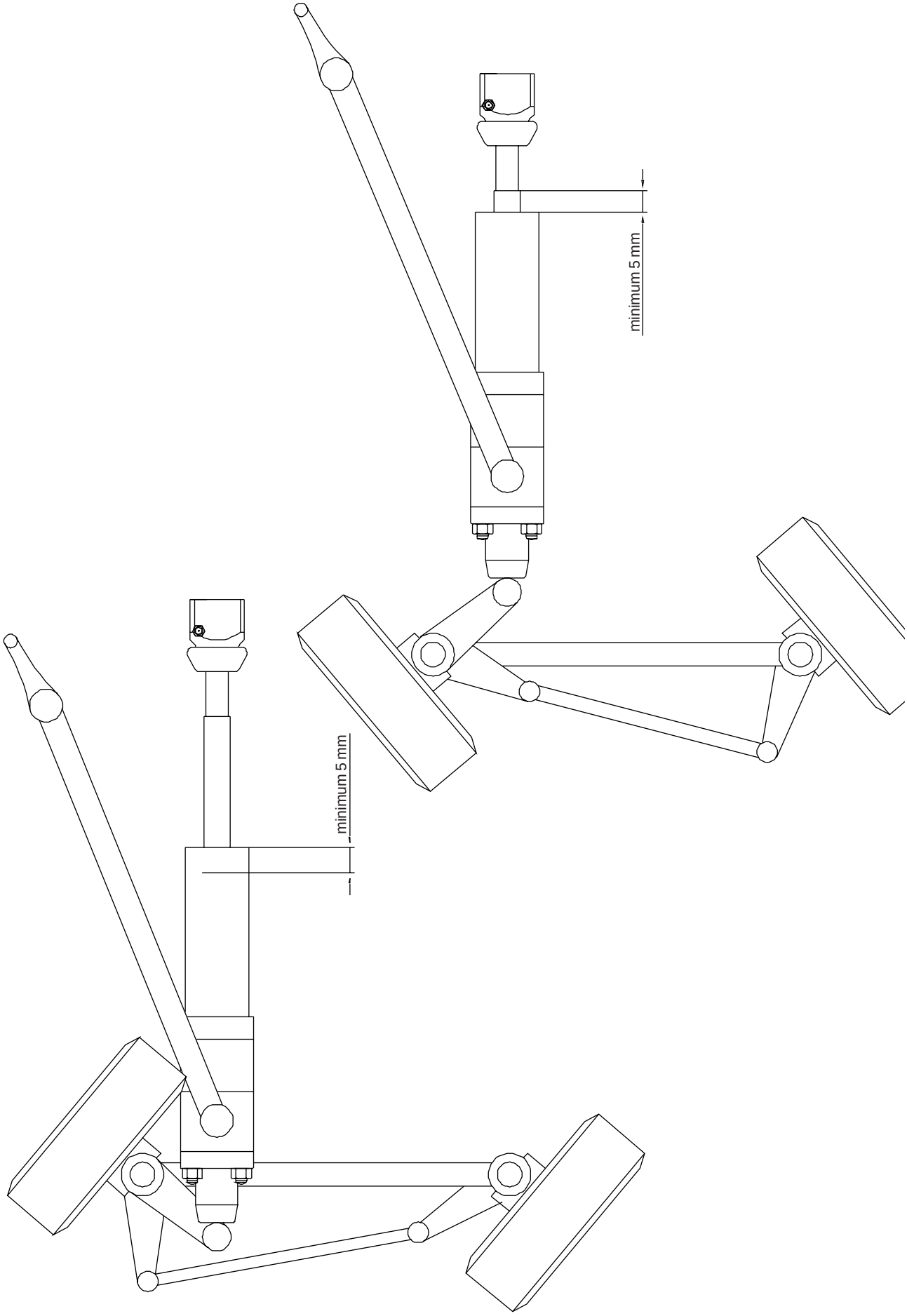
If not, and if these details were not followed, it might not work properly, causing the distributor to be moved more than necessary to one side, and as a result, it would only operate in one direction when the steering wheel were activated (right or left) and it would not work in the other direction.



STROKE STOPPERS

It is absolutely necessary to place stoppers, if possible adjustable by means of screw, nut and locknut, on both sides of the connecting rod which comes from the steering box and will be able to be adjusted so that the stopper in the connecting rod is reached before those which are on the wheels (see following diagram).

This detail must be respected, so that, when the end of the stroke is reached, the hydraulic pump is not working at maximum pressure, with which its life would be considerably shortened. At the same time it avoids forcing the various steering mechanisms, lever and ball and socket joint.


minimum 5 mm
minimum 5 mm

INSTALLATION OF PIPING

1.- PRESSURE PIPES

The outlet pressure pipe of the pump will always be made of synthetic rubber for a pressure of 200 kg/cm2 and with an inner diameter of 7 mm.

The pipe which reaches the distributor will also be of synthetic rubber for a pressure of 200 kg/cm2 and with a minimum inner diameter of 7 mm.

The joint between the two pies mentioned above will be able to be done directly or with a metal tube with inner diameter of 8 or 9 mm., and the joints will be made by means of connectors.

2.- RETURN PIPE

The return pipe from the distributor to the tank can be of synthetic rubber, with a minimum inner diameter of 13 mm. and must respond to an explosion pressure of 15 atm. minimum.

WARNING: Be careful that the pipes are not forced in any position caused by the complete movement of the wheels and that they do not have very small curves of radius either. The length of these pipes must not be too long either.

STARTING UP

Once the TDZ SERVO-STEERING unit has been assembled, before filling it with liquid, it is better to make sure that:

a) On turning the wheels to one end or the other of their total run the cylinder and the pipes do not touch any mechanism.

b) On lifting the wheels as far as their stoppers allow it, on one side or the other, the cylinder must not be forced in the position adopted.

c) Check that all the connectors and nuts of the pipers are well adjusted to prevent oil leakages.

Once these points have been checked, take off the butterfly screw placed on the tank cover, lift said cover and fill with liquid until the height of the central stud. Place the cover with the screw, fasten it down by hand and start the engine without acelerating.

Afterwards turn the steering wheel from two to four times in its whole run and leave the wheels turned towards the side where the cylinder plunger is totally hidden.

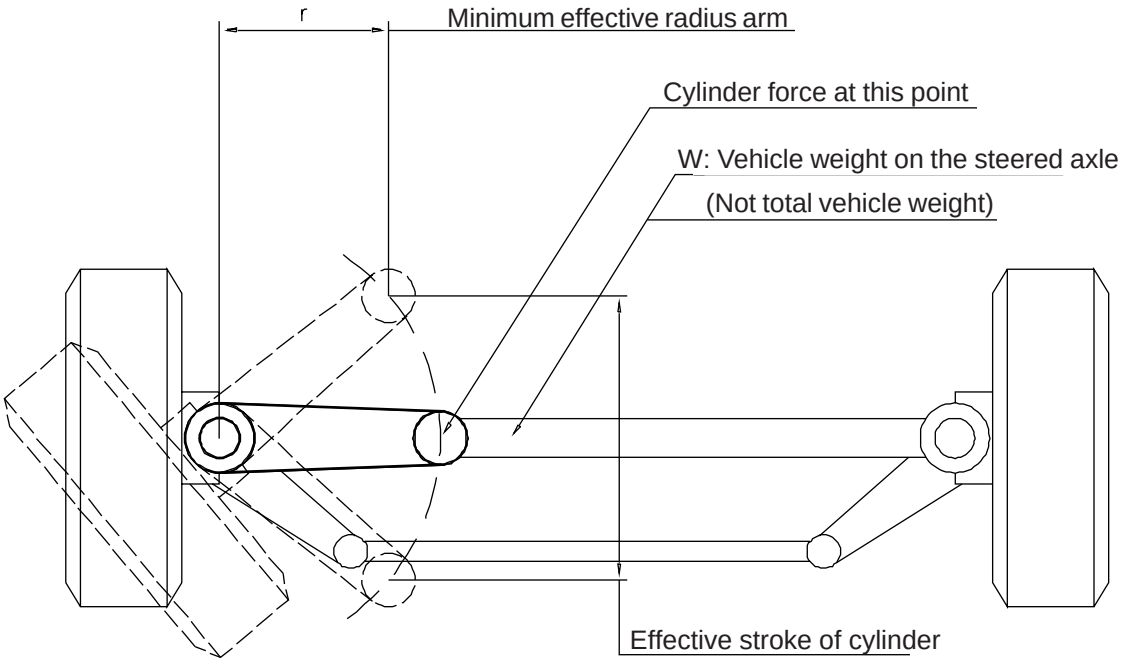
Stop the engine, lift off the tank cover and refill with liquid until the central stud is covered, considering the level to be correct up to about 3 mm. above this stud.

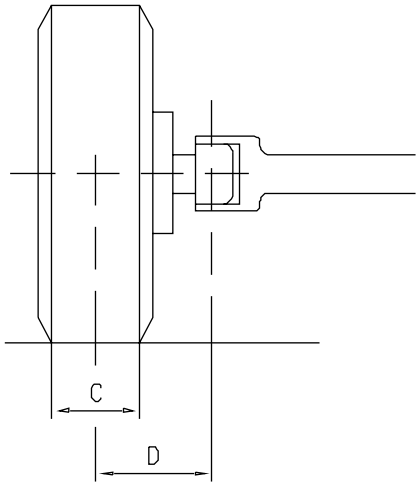
Lastly, place the cover, making sure with a turning movement that it is correctly placed, fastening it with the butterfly screw without using any tool, but only with the pressure of the fingers.

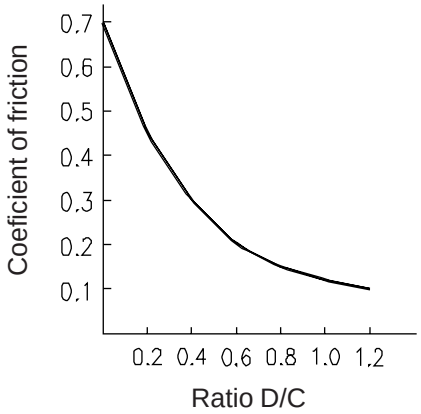
Start the engine again, turn the steering wheel several times to one side and the other, until the buzzing noise produced by the pump on working with the oil mixed with air starts getting less.

As a last check, make sure that no leak exists, that no pin, screw, connector or nut has not been assembled.

FORMULA TO CALCULATE THE KINGPIN TORQUE AND SELECTION OF REQUIRED CYLINDER







CALCULATE TORQUE REQUIRED AT THE KINGPIN FOR STEERING WITH THIS FORMULA

$$T = n\,W\,U\sqrt{\frac{C^2}{8} + D^2}$$

T: Kingpin torque.

W: Vehicle weight on the steered axle. Note that this is not total vehicle weight, only the part of the weight which is on the steered axle.

U: Coefficient of friction between tyre and road. This can be assumed to be 0.7 for most applications, but for narrow tyres would be less, and can be taken from the graph.

C: Nominal width of tyre.

D: Kingping offset. This is the distance, measured on the road, between tyre centerline and kingpin projection onto the road.

N: Number of driving wheels.

NOMENCLATURE OF THE ELEMENTS USED IN THE TDZ SERVO-STEERING

VANE PUMPS

Type	*Tank (l.)*	*Flow at 1000 r.p.m. (l/min.)*
B2V	without tank	until 15
B2VC	1,5	until 12
B2VA	1	until12

PULLEYS

Pulley reference	*Dimensions (Diameter x channel witdh)*	*Nº channels*
PV01011	105 x 10 mm.	1
PV01000	134 x 10 mm.	1
PV01005	134 x 16 mm.	1
PV01008	134 x 10 / 10 mm.	2

TANKS

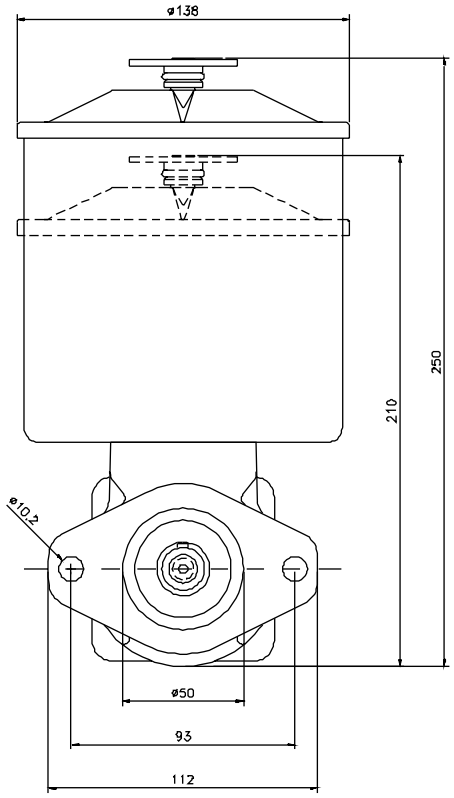
Reference	*Capacity (l.)*	*Installation*
FR03100	1	Coupled to the pump
FR05050	1	Independent of the pump
FR05000	1	Independent with support
FR02100	1,5	Coupled to the pump
FR01000	1,5	Independent of the pump
FR04000	1,5	Independent with support

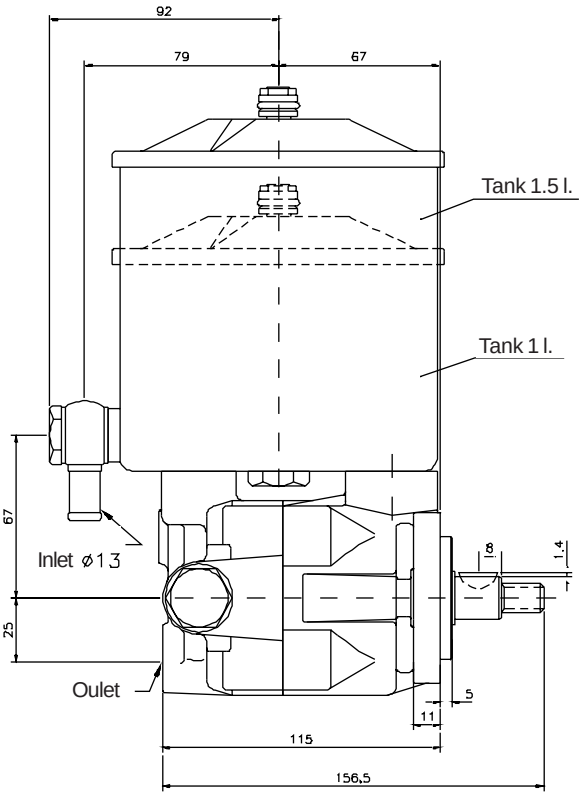
SERVO-STEERING CYLINDER

Manufactured standard types
C-35-220/..
C-40-275/..
C-50-240/..
C-50-295/..
C-50-350/..

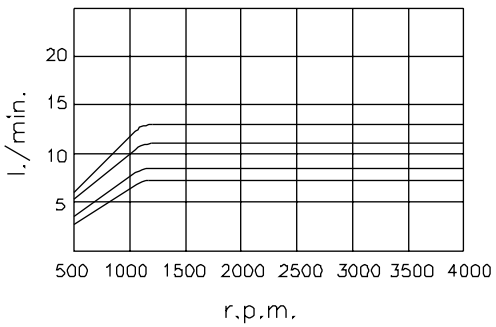
HYDRAULIC VANE PUMP TYPE B2VC

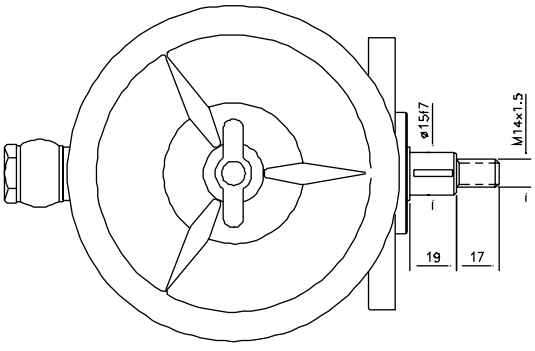
With flow regulation valve and safety valve





Outlet constant maximum flow



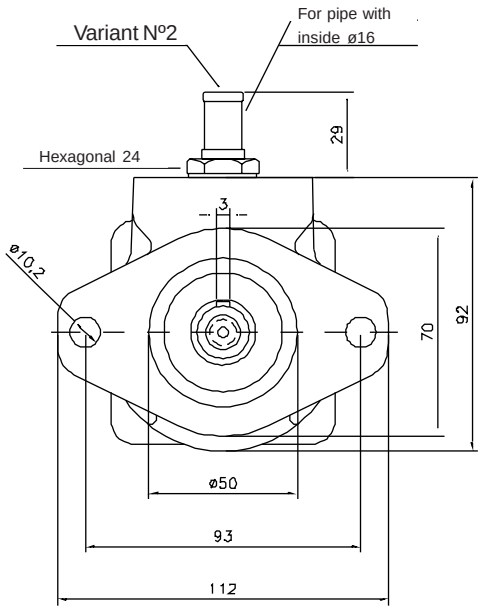


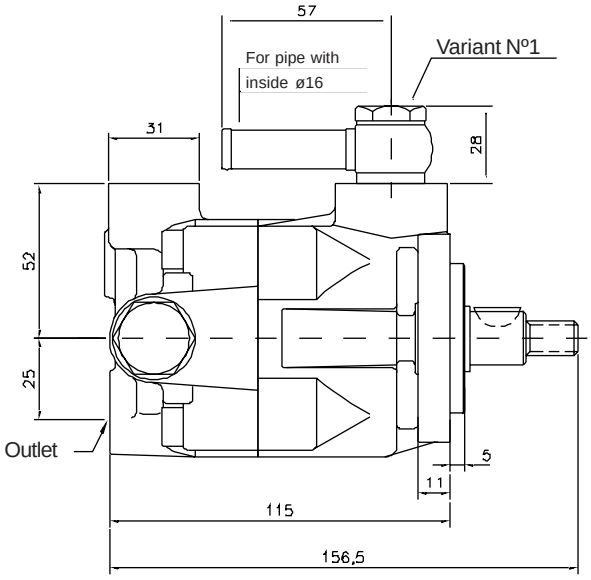
TYPE	FLOW (cc/rev.)	MAX. PRESSURE (Bar)	MAXIMUM R.P.M.
B2VC.	7	140	4000
	8		
	10	120	
	12		

HYDRAULIC VANE PUMP TYPE B2VC

Can be supplied with the valve setting from 15 up to 140 bar

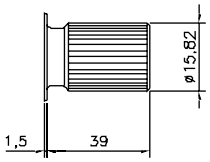
Weight: 4,3 kg



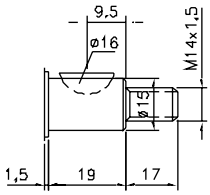


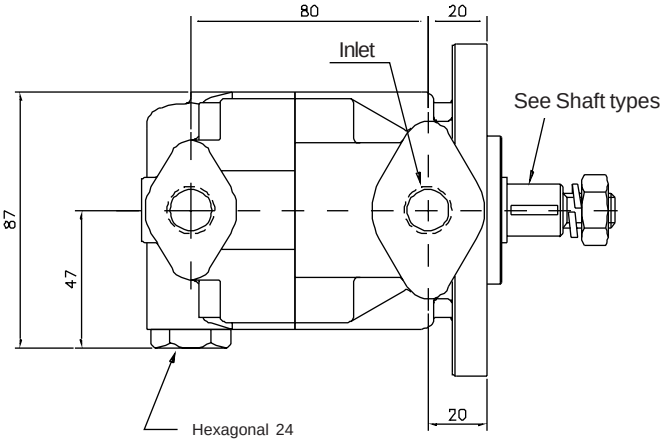
Shaft type nº 2

Diametral Pitch 16/32
Teeth number: 9

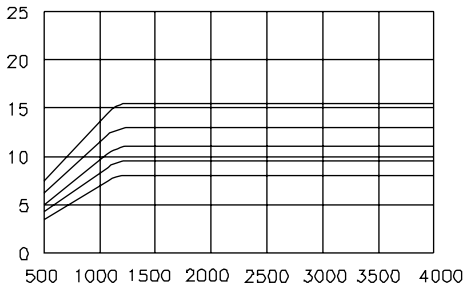


Shaft type nº 3



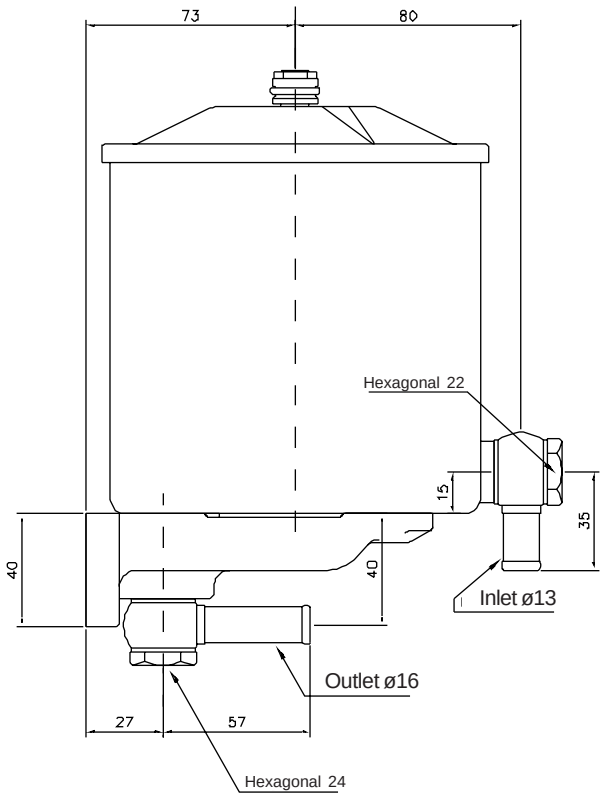


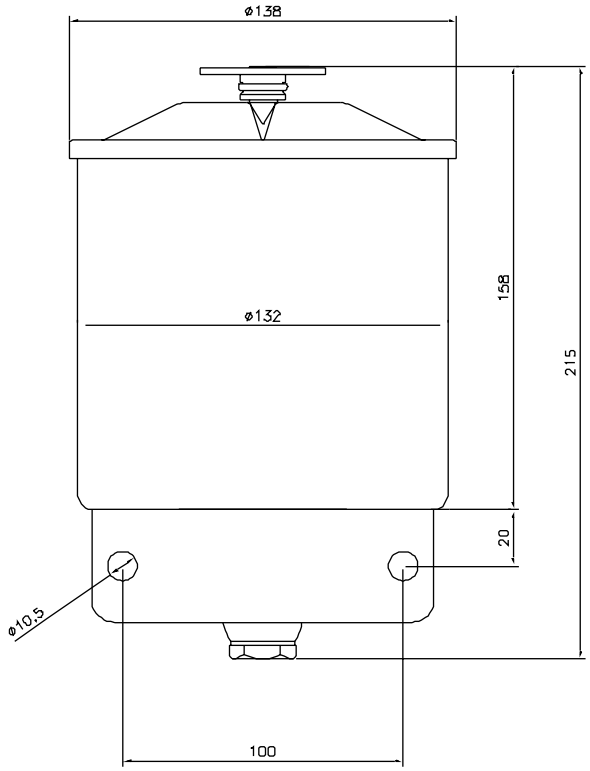
Flow diagram

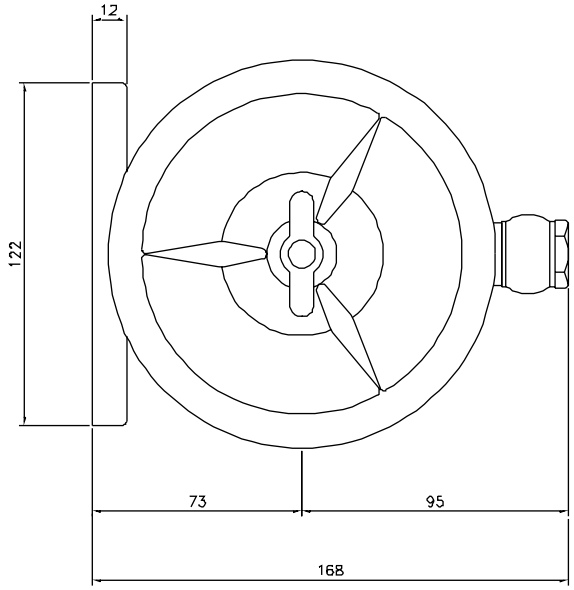


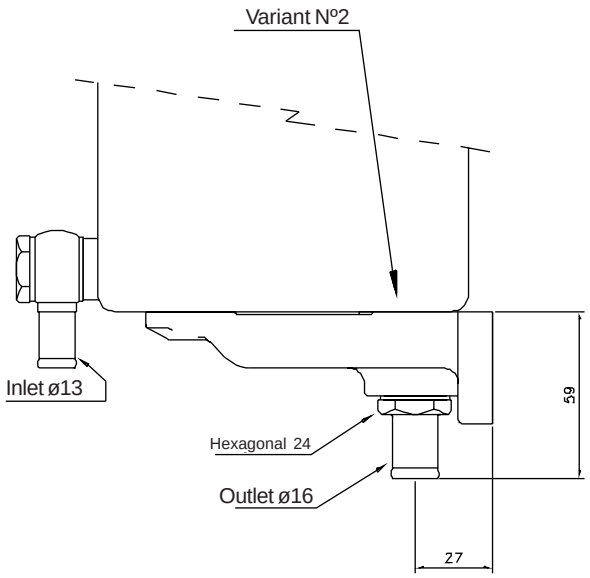
1.5 TANK FOR INDEPENDENT TANK PUMP
TYPE FR04000

Weight: 2,3 kg.



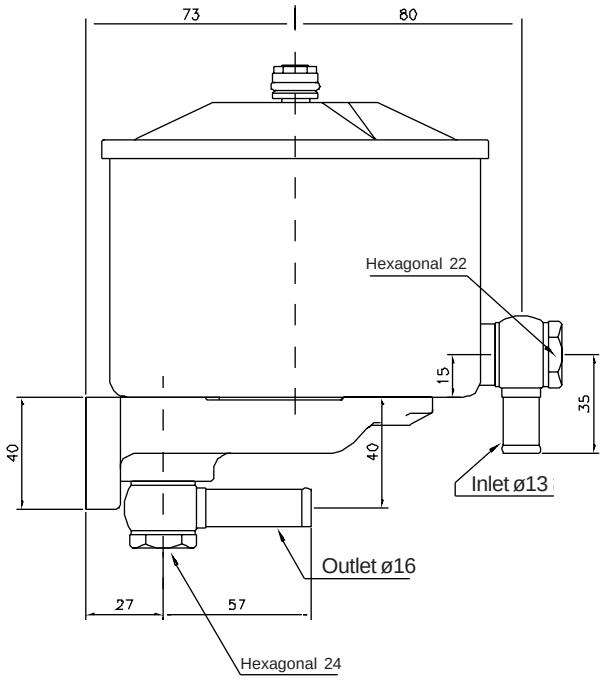


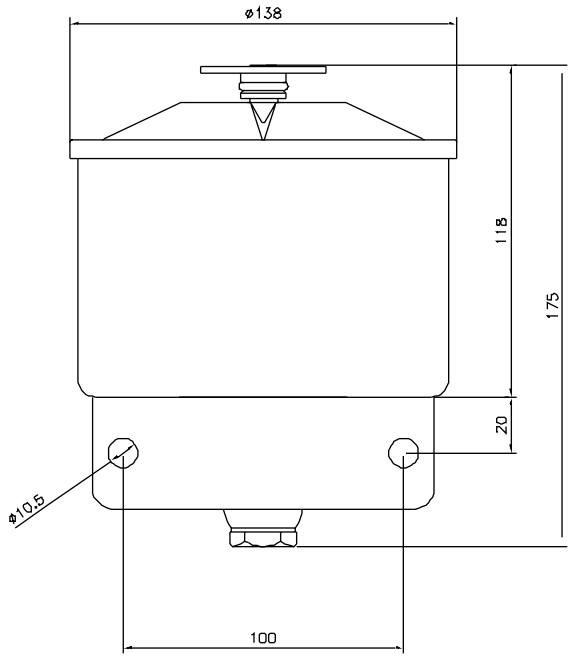


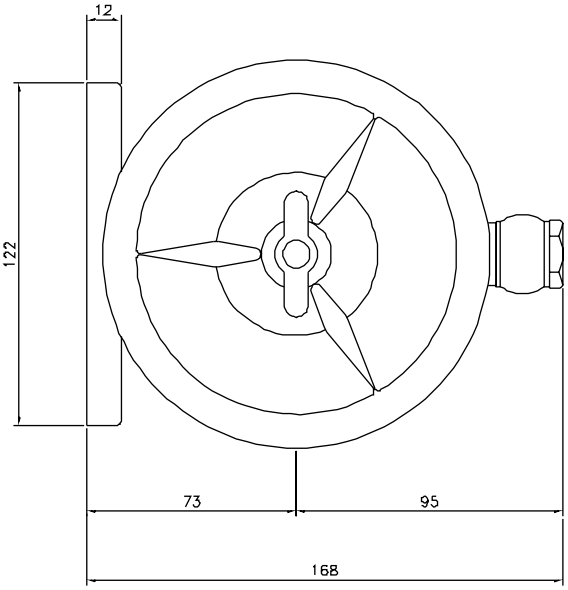


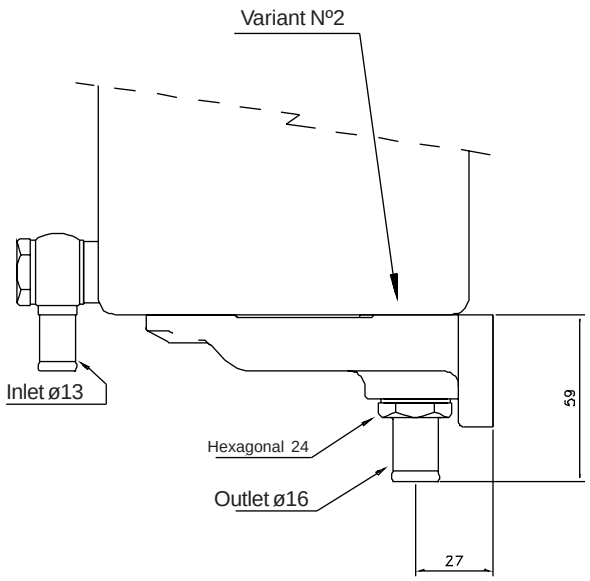
1 LITRE TANK FOR INDEPENDENT TANK PUMP
TYPE FR 05 000

Weight: 1,8 kg.



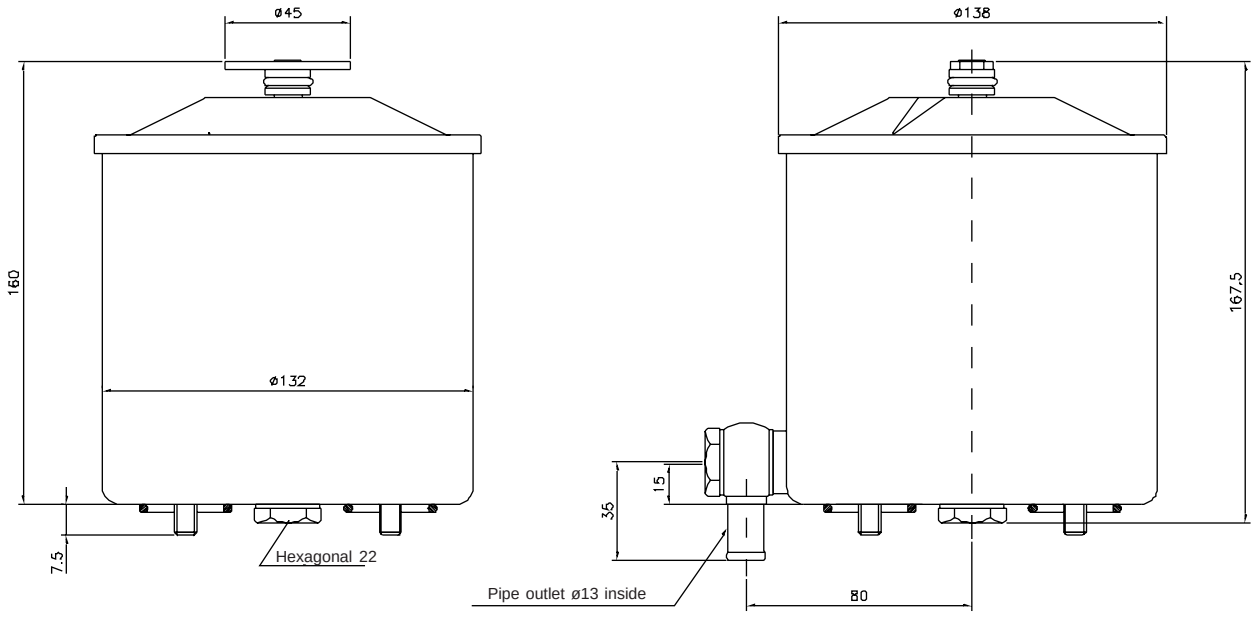


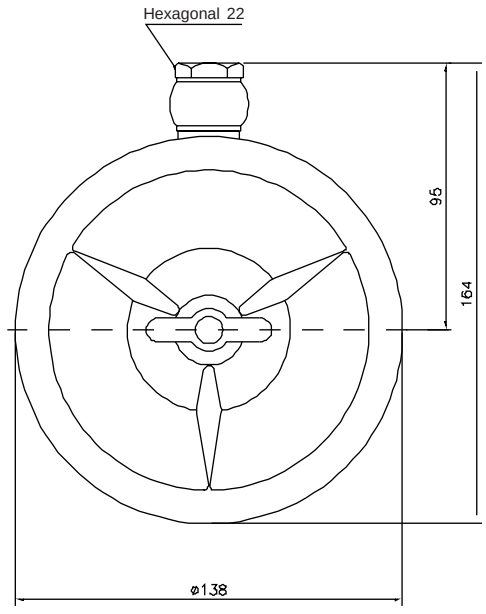




1.5 LITRE TANK FOR INCORPORATED TANK PUMP
TYPE FR 02 100

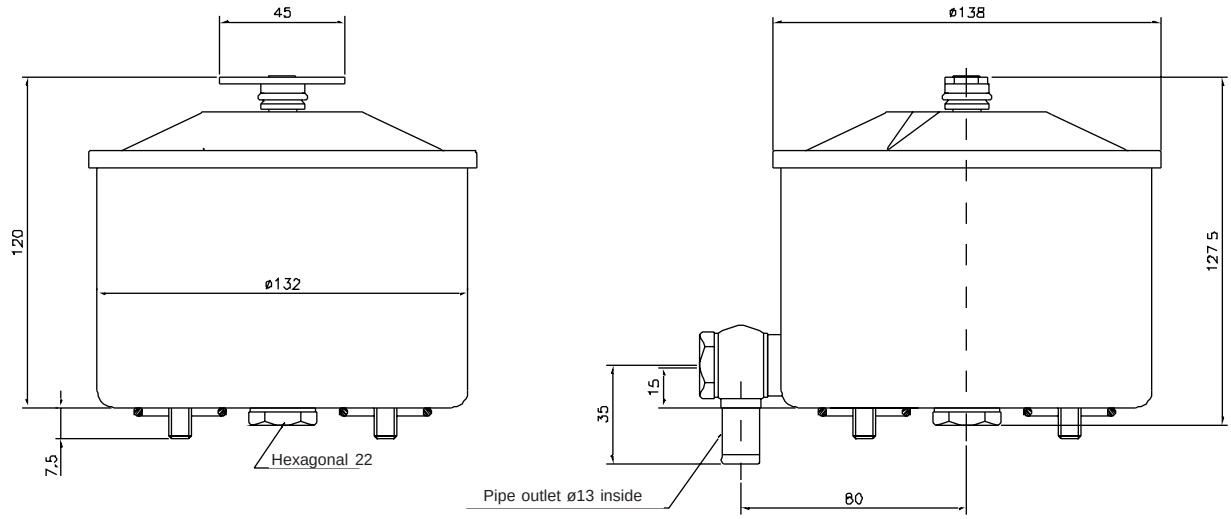
Weight: 1,875 kg.

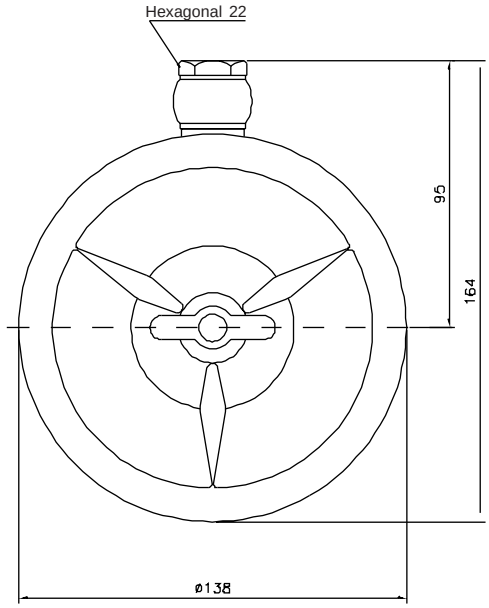




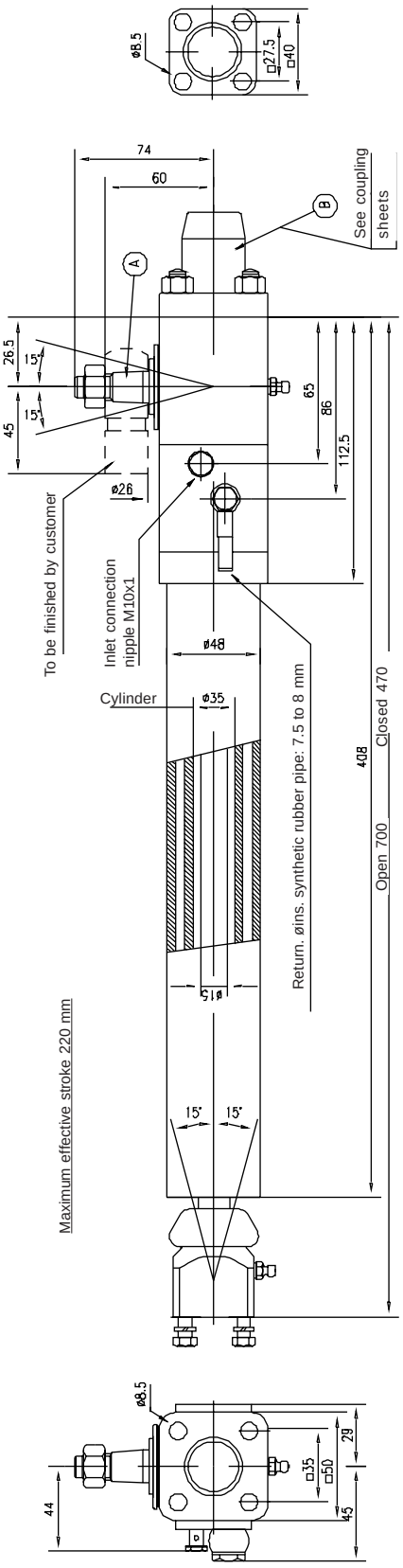
1 LITRE TANK FOR INCORPORATED TANK PUMP
TYPE FR 03 100

Weight: 1,25 kg.

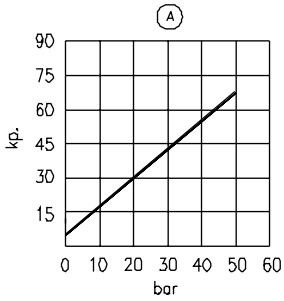




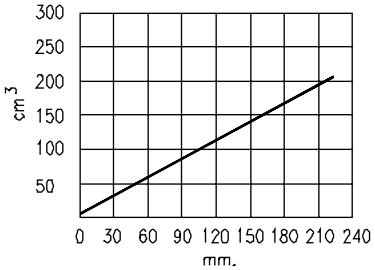
POWER STEERING CYLINDER C-35-220



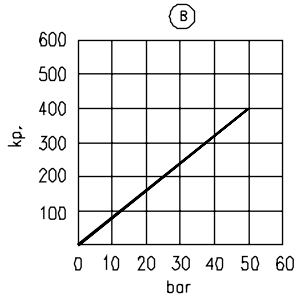
Pressure- Force Diagram for the Servo-steering Drive



Cylinder Volume - Stroke Diagram

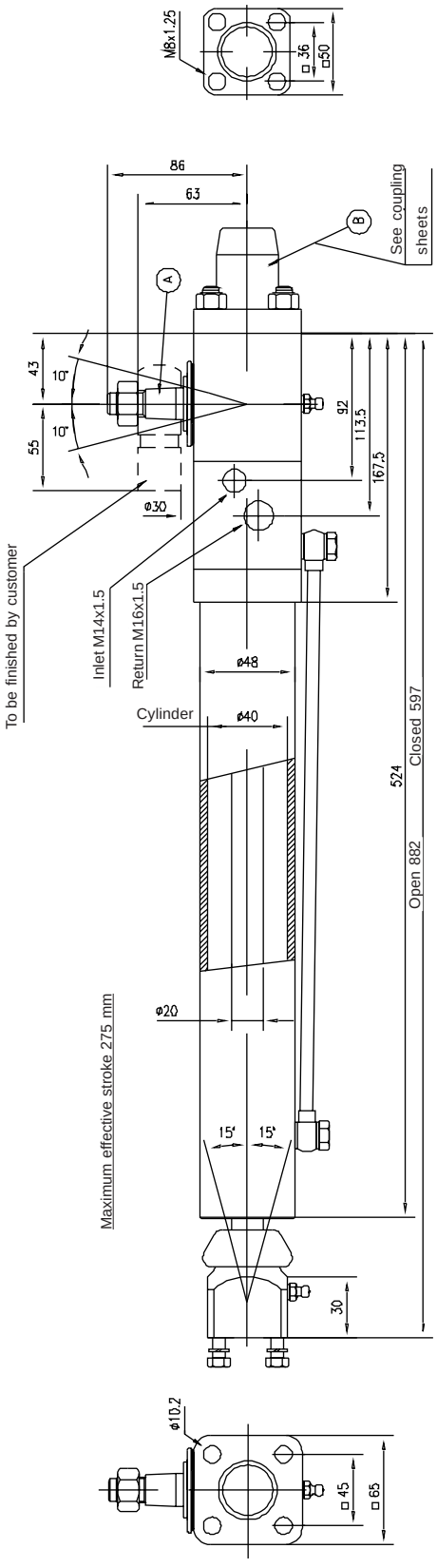


Cylinder Pressure - Force Diagram

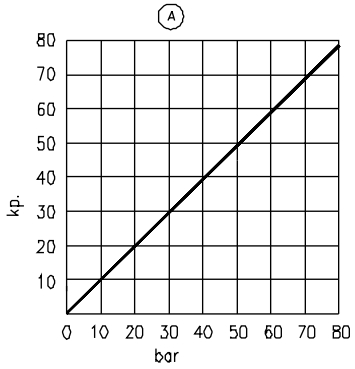


Cylinder Weight without oil:
Individual cartoon box included: 5.1 kg.
Without package: 4.8 kg.

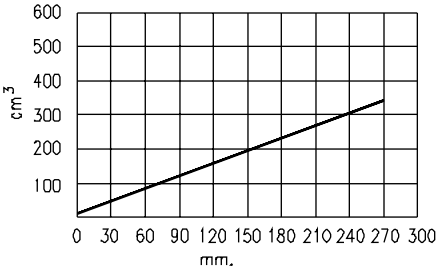
POWER STEERING CYLINDER C-40-275



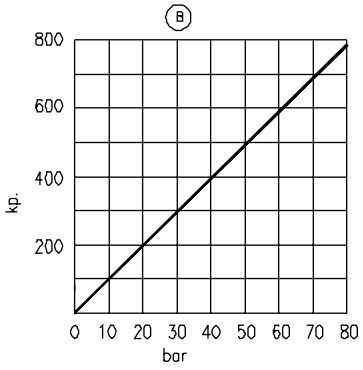
Pressure - Force Diagram for the Servo-steering Drive



Cylinder Volume - Stroke Diagram

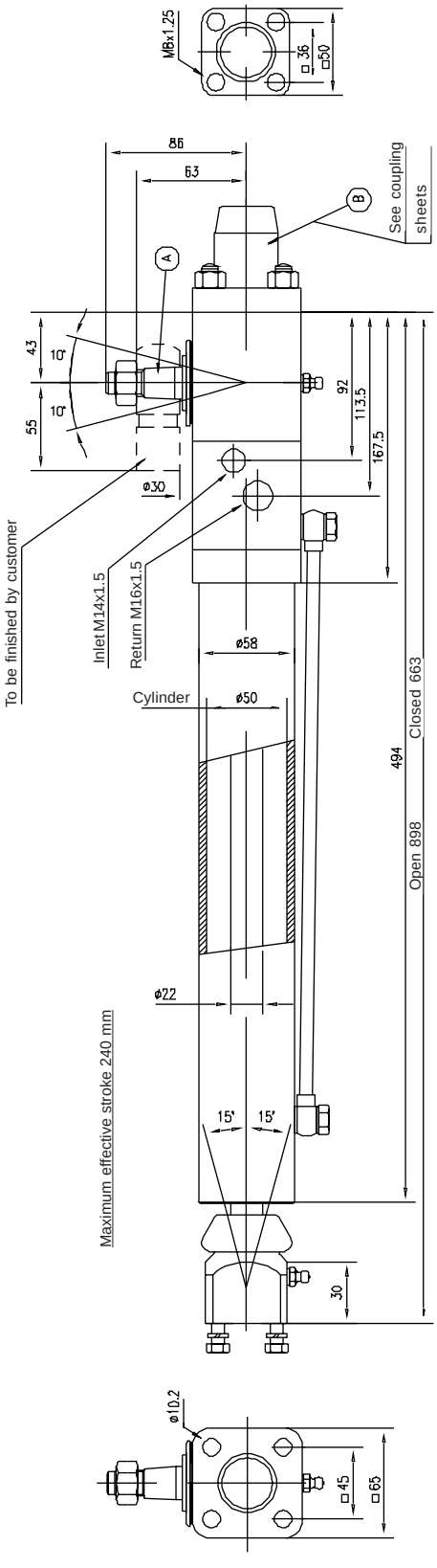


Cylinder Pressure - Force Diagram

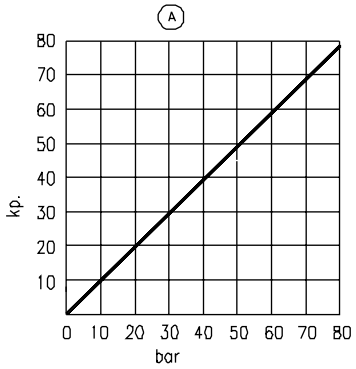


Cylinder weight without oil:
Individual cartoon box included: 10.5 kg.
Without package: 9.5 kg.

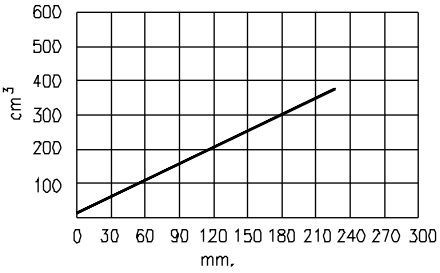
POWER STEERING CYLINDER C-50-240



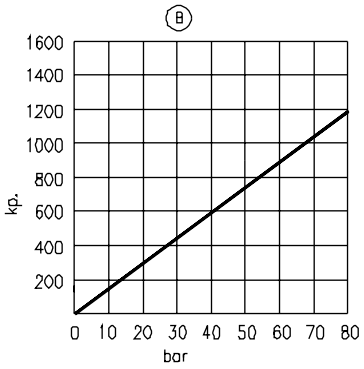
Pressure - Force Diagram for the Servo-steering Drive



Cylinder Volume - Stroke Diagram

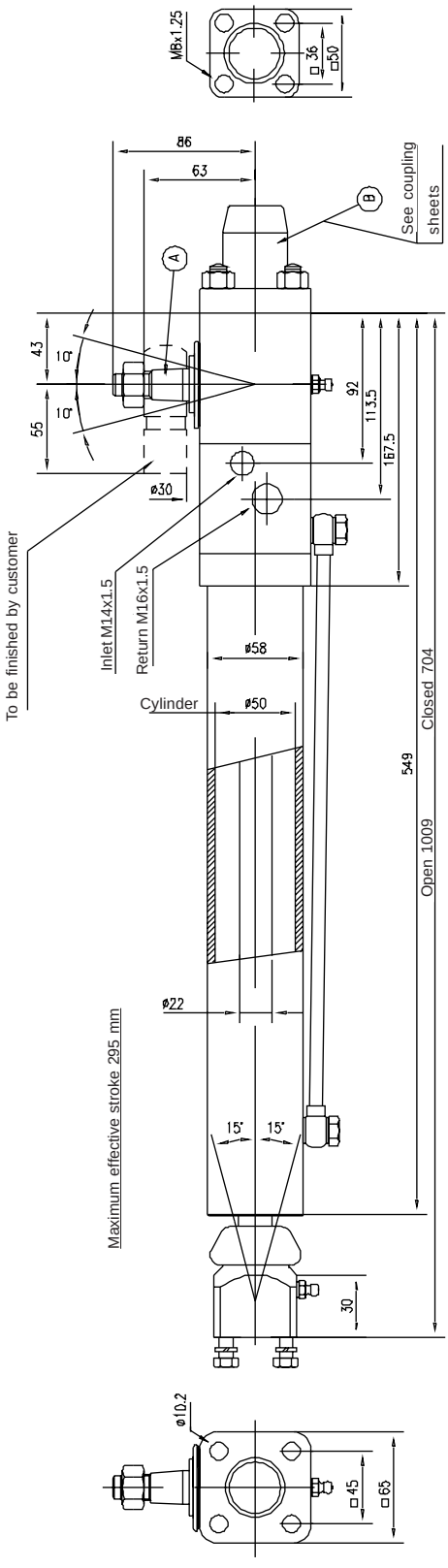


Cylinder Pressure - Force Diagram

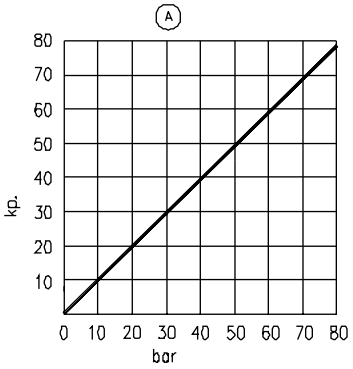


Cylinder weight without oil:
Individual cartoon box included: 12 kg.
Without package: 11 kg.

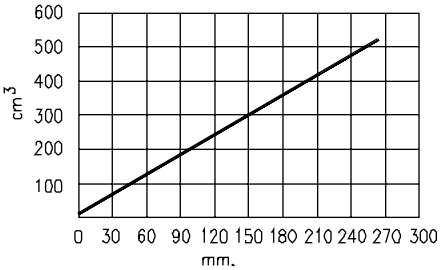
POWER STEERING CYLINDER C-50-295



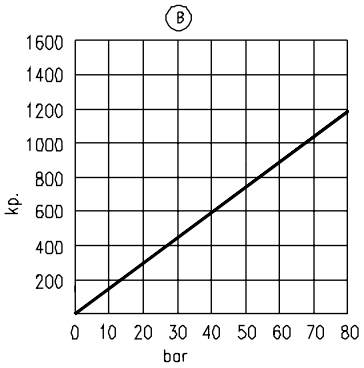
Pressure - Force Diagram for the Servo-steering Drive



Cylinder Volume - Stroke Diagram

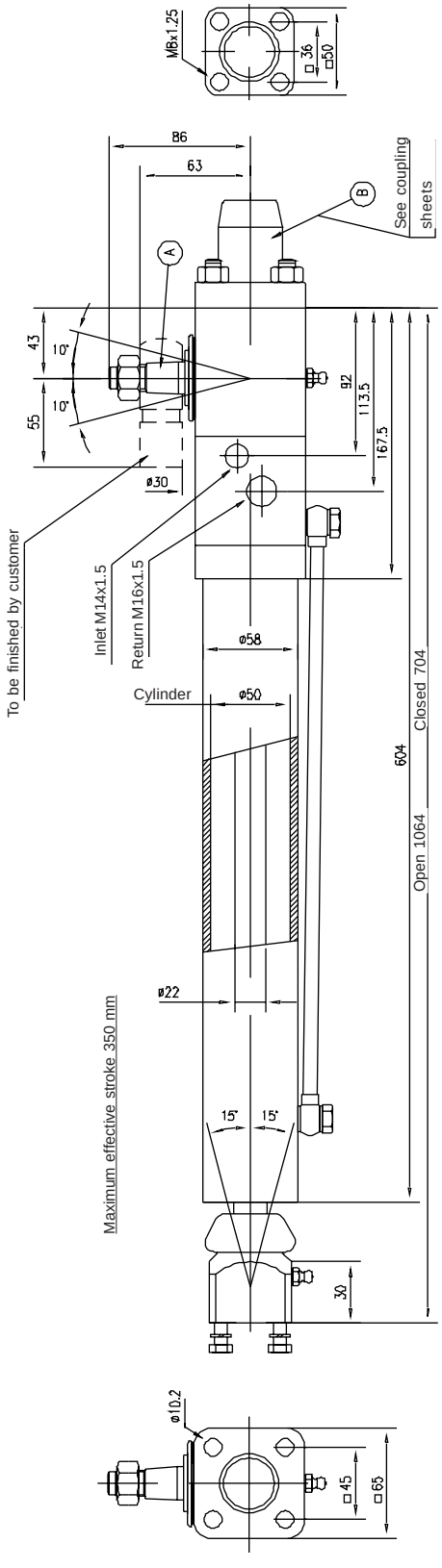


Cylinder Pressure - Force Diagram

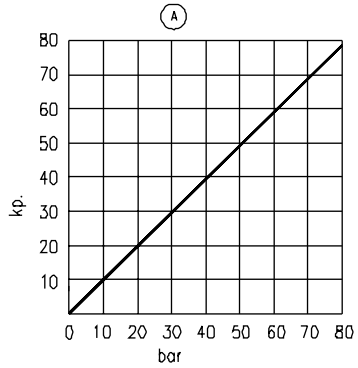


Cylinder weight without oil:
Individual cartoon box included: 12.5 kg.
Without package: 11.5 kg.

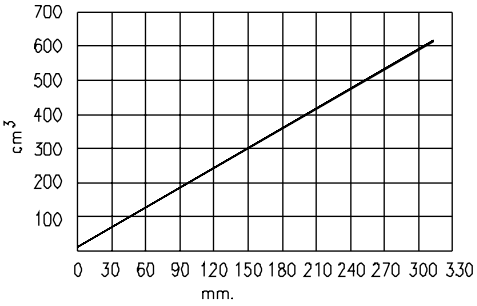
POWER STEERING CYLINDER C-50-350



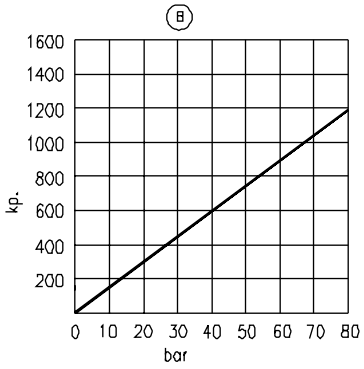
Pressure - Force Diagram for the Servo-steering Drive



Cylinder Volume - Stroke Diagram



Cylinder Pressure - Force Diagram



Cylinder Weight without oil:
Individual cartoon box included: 12.75 kg.
Without package: 11.75 kg.